New Neutron Cross-Section Measurements at ORELA for Improved Nuclear Criticality Calculations

Klaus H. Guber, Luiz C. Leal, Royce O. Sayer, Paul E. Koehler, Timothy E. Valentine, Herve Derrien, Jack A. Harvey

Oak Ridge National Laboratory

Concerns about using existing cross-section evaluations from libraries such as ENDF/B-VI or JENDL-3.2 for nuclear criticality calculations have been a prime motivator for new cross-section measurements at the Oak Ridge Electron Linear Accelerator (ORELA). Most of the older neutron cross section data show deficiencies or do not cover the energy range that currently is important for a wide variety of applications.

Many of the evaluations found in these libraries were derived from measurements made with poor time-of-flight resolution, and also the description of some data in the neutron energy range above several tens of keV is crude. This impacts not only the resolved resonance region but also the unresolved region, and could lead to problems in processing data from the libraries and also to erroneous Maxwellian average cross sections. As a consequence, these evaluated data may not have sufficient quality for nuclear criticality calculations wherein effects such as self shielding, multiple scattering, or Doppler broadening can be important. Furthermore, many evaluations for nuclides having small neutron-capture cross sections are erroneously large because the neutron sensitivity of the old measurements was underestimated. Although their neutron capture cross sections are small, these nuclides can be important absorbers in many criticality calculations, so accurate determinations of these cross sections can be very important.

Over the last three decades ORELA has produced many neutron induced cross section data. It is the only high power white neutron source with excellent time resolution still operating in the USA, and is ideally suited for experiments to measure neutron total and capture cross sections in the energy range from 1 eV to ∼600 keV.

In this paper the facility and experimental setup at ORELA will be described and the results of the new measurements for Fluorine and Potassium will be discussed

ORNL is managed by UT-Battelle, LLC for the US Department of Energy under Contract No. DE-AC05-00OR22725.

Email: guberkh@ornl.gov